in producing superior offspring. It is shown, for example, that if an individual who possesses a degree of character only found in one in twenty be considered "exceptional," then eighteen times as many exceptional men will be born of non-exceptional parents as of exceptional parents; but on the other hand, exceptional parents produce exceptional offspring at a rate ten times as great as non-exceptional parents, the greater gross product of the latter being due to their much greater numbers. In other words, distinguished parents are more likely to have distinguished offspring than undistinguished—ten times as likely—and yet only one distinguished man in nineteen will be born of distinguished parents. The importance of such conceptions for both natural and artificial breeding can hardly be over-estimated.

March 8, 1900.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The Bakerian Lecture, "The Specific Heat of Metals and the Relation of Specific Heat to Atomic Weight," was delivered by Professor W. A. Tilden, F.R.S.

BAKERIAN LECTURE.—"On the Specific Heat of Metals and the Relation of Specific Heat to Atomic Weight." By W. A. TILDEN, D.Sc., F.R.S., Professor of Chemistry in the Royal College of Science, London. With an Appendix by Professor JOHN PERRY, F.R.S. Received February 9,—Read March 8, 1900.

(Abstract.)

The experiments described in this paper were begun with the object of assisting in the determination of the relative values of the atomic weights of cobalt and nickel, but were continued with the further purpose of testing the validity of the law of Dulong and Petit.

The metals cobalt and nickel closely resemble each other in density, melting point, and other physical properties, as well as in atomic weight. The pure metals were prepared for the purposes of these experiments with the most scrupulous care, the cobalt by taking

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advantage of the slight solubility of purpureo-cobaltamine hydrochloride in strongly acid solutions, and the nickel by deposition from the carbonyl compound and subsequent solution of the metal and electro deposition. Both were fused by means of an oxyhydrogen flame, and afterwards shaped into bars. For the estimations of specific heat between 15° C. and 100° C. the differential steam calorimeter of Professor Joly was employed.

The mean specific heat of cobalt within these limits of temperature was found to be 0·10303.

The mean specific heat of nickel was found to be 0·10842.

In order further to test the method and the conclusion from the case of cobalt and nickel, gold was compared with platinum, and copper with iron.

The following are the mean specific heats for these pure metals after fusion, and within the same limits of temperature :—

Gold	0·03035
Platinum	0·03147
Copper	0·09232
Iron	0·10983

When these values for the specific heats are multiplied by the respective atomic weights of the several metals, the products are not constant, as the law of Dulong and Petit would seem to require if applicable at all temperatures.

The influence of impurities on the specific heat of several metals was then investigated, and a number of results are given, from which it appears that small quantities of carbon or other non-metallic element tend to increase the specific heat appreciably, while the presence of a small quantity of a foreign metal seems to produce little effect.

A series of calorimetric experiments were next made by the method of mixtures on the two pure metals cobalt and nickel, at the temperature of solid carbon dioxide, −78·4°, and at that of boiling oxygen, −182·5°.

The results, which are given below, show that as the temperature is reduced the value for nickel declines more rapidly than that for cobalt, and hence that, when the mean results are plotted out, the curves steadily approach each other.

The mean specific heats of cobalt and nickel now stand as follows :—

Temperature.	Cobalt.	Nickel.
From 100° to 15°	0·10303	0·10842
„ 15° „ −78·4°......	0·0939	0·0975
„ 15° „ −182·4° ...	0·0822	0·0838

and by calculation from the last two results from −78·4 to −182·4°, 0·0712, 0·0719.

It seems probable that at absolute zero the values of the products of specific heat, multiplied by atomic weight, would be identical, or differ only by the very small amount due to experimental error.*

Appendix.

The following calculations have been made by E. R. Verity, Assoc. R.C.S., and H. L. Mann, Assoc. R.C.S.:—

If cobalt and nickel were in the states of perfect gases, their specific heats at constant volume would be

$$k_0 = 0{\cdot}04123 \text{ for cobalt.}$$

$$k_0 = 0{\cdot}04145 \text{ for nickel.}$$

This is on the assumption that k_0 multiplied by the atomic weight is the same as for hydrogen. It is not unreasonable to assume that in no state can the substance have a smaller specific heat than k_0. It is easy to show that for any of the metals the specific heat at atmospheric pressure K is not more than 2 per cent. different from the specific heat under any other condition, such as great hydrostatic pressure, to keep its volume constant. Our ignorance of the molecular state of a solid is so great, that we cannot even speculate on how it is that when 1 gramme of cobalt (we have much the same figures for other metals) at 50° C. rises in temperature to 51° C., whether it is allowed to expand freely or is subjected to great hydrostatic pressure which prevents expansion, the energy 0·041 enters it as what may be called the real sensible heat, and the energy 0·062 enters it as some kind of energy of disgregation, necessary because of change of temperature, and having nothing to do with change of volume or pressure. The facts are not explainable by assuming that the atomic weights are wrong, because, as we see from cobalt and nickel, K approaches the value k_0 at low temperatures. Indeed, if the following formula is correctly deduced from the above measurements, we may say that in the solid state the product of the atomic weight and specific heat may be anything between what it is for hydrogen and 2·7 times this amount. The formula is

$$K = k_0 + \frac{bt^3}{1 + ct^3},$$

where t is the absolute temperature.

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* *Note added March* 3.—Further experiments made, since the date of communication, upon the metals silver, copper, iron, and aluminium show, however, that this suggestion will not be realised. The mean specific heat of silver between 15° and 182·4°, for example, is 0·0519, while from 100° to 15° it is 0·0558. The decrease of specific heat at the lower temperature is therefore much less than in the case of cobalt and nickel.

	Cobalt.	Nickel.
k_0.	0·0412	0·0415
b	$1{\cdot}764 \times 10^{-8}$	$1{\cdot}764 \times 10^{-8}$
c	$2{\cdot}55 \times 10^{-7}$	$2{\cdot}35 \times 10^{-7}$

This formula must give fairly correct values of K from − 180° C. to 100° C.

March 15, 1900.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug." By Sir NORMAN LOCKYER, K.C.B., F.R.S., Captain CHISHOLM-BATTEN, R.N., and Professor PEDLER, F.R.S.

II. "A Comparative Crystallographical Study of the Double Selenates of the Series $R_2M(SeO_4)_2,6H_2O$. Part I.—Salts in which M is Zinc." By A. E. TUTTON, F.R.S.

III. "The Theory of the Double Gamma Function." By E. W. BARNES. Communicated by Professor FORSYTH, F.R.S.

"Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug." By Sir NORMAN LOCKYER, K.C.B., F.R.S., Captain CHISHOLM-BATTEN, R.N., and Professor A. PEDLER, F.R.S. Received January 25,—Read February 22, 1900.

(Abstract.)

The paper is in three parts. The first, by Sir Norman Lockyer, gives an account of the arrangements made for the observations and the general conditions of the eclipse; but the results obtained with the